

## COVER SHEET (PAGE 1 of 2)

## May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Proposal Title: Spacial and seasonal abundance of aquatic piscivores, Sacramento Squawfish *Ptychocheilus grandis* and Striped Bass *Morone saxatilis*, around the various in-river structures associated with water diversion activities at Red Bluff Diversion Dam, Sacramento River, California

Applicant Name: U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office.

Mailing Address: 10950 Tyler Road, Red Bluff, CA 96080

Telephone: (530)527-3043  
Fax (530)529-0292

Amount of funding requested: \$88,400 for 1 year

Indicate the Topic for which you are applying (check only one box). Note that this is an important decision: see page 8 of the Proposal Solicitation Package for more information

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> Fish Passage Assessment                               | <input type="checkbox"/> Fish Passage Improvements    |
| <input type="checkbox"/> Floodplain and Habitat Restoration                               | <input type="checkbox"/> Gravel Restoration           |
| <input type="checkbox"/> Fish harvest   | <input type="checkbox"/> Species Life History Studies |
| <input type="checkbox"/> Watershed Planning/Implementation                                | <input type="checkbox"/> Education                    |
| <input type="checkbox"/> Fish Screen Evaluations - Alternatives and Biological Priorities |   |

Indicate the geographic area of your proposal (check only one box):

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> Sacramento River Mainstem   | <input type="checkbox"/> Sacramento Tributary: _____      |
| <input type="checkbox"/> Delta                                  | <input type="checkbox"/> East Side Delta Tributary: _____ |
| <input type="checkbox"/> Suisun Marsh and Bay                   | <input type="checkbox"/> San Joaquin Tributary: _____     |
| <input type="checkbox"/> San Joaquin River Mainstem             | <input type="checkbox"/> Other: _____                     |
| <input type="checkbox"/> landscape (entire Bay-delta watershed) | <input type="checkbox"/> North Bay: _____                 |

Indicate the primary species which the proposal addresses (check no more than two boxes):

- |  |   |
|--|---|
| <input type="checkbox"/> San Joaquin and East-side Delta tributaries fall-run chinook salmon | <input type="checkbox"/> Spring-run chinook salmon  |
| <input checked="" type="checkbox"/> Winter-run chinook salmon                                | <input type="checkbox"/> Fall-run chinook salmon    |
| <input type="checkbox"/> Late-fall run chinook salmon  | <input type="checkbox"/> Longfin smelt              |
| <input type="checkbox"/> Delta smelt   | <input checked="" type="checkbox"/> Steelhead trout |
| <input type="checkbox"/> Splittail   | <input type="checkbox"/> Striped bass               |
| <input type="checkbox"/> Green sturgeon  |   |
| <input type="checkbox"/> Migratory birds   |   |

COVER SHEET (PAGE 2 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Indicate the type of applicant (check only one box):

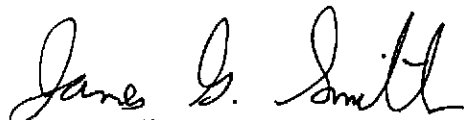
- |  |  |
|--|--|
| <input type="checkbox"/> State agency                    | <input checked="" type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit                |
| <input type="checkbox"/> Local government/district       | <input type="checkbox"/> Private party             |
| <input type="checkbox"/> University                      | <input type="checkbox"/> Other: _____              |

Indicate the type of project (check only one box):

- |  |   |
|--|---|
| <input type="checkbox"/> Planning              | <input type="checkbox"/> Implementation |
| <input checked="" type="checkbox"/> Monitoring | <input type="checkbox"/> Education      |
| <input type="checkbox"/> Research              |   |

By signing below, the applicant declares the following:

- (1) the truthfulness of all representations in their proposal;
- (2) the individual signing the form is entitled to submit the application on behalf of the applicant (if applicant is an entity or organization); and
- (3) the person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section II.K) and waives and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.



(Signature of Applicant)

- a. **Title.**—Spacial and seasonal abundance of aquatic piscivores, Sacramento squawfish *Ptychocheilus grandis* and striped bass *Morone saxatilis*, around the various in-river structures associated with water diversion activities at Red Bluff Diversion Dam, Sacramento River, California
- Applicant.**—U. S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office, Red Bluff, California.
- b. **Project Description.**—The goal of this project is to determine if man-made structures at Red Bluff Diversion Dam (RBDD) are constructed and operated in a manner that creates no new local attraction for aquatic piscivores and no increase in predation on downstream migrating juvenile chinook salmon *Oncorhynchus tshawytscha* and steelhead trout *Oncorhynchus mykiss*. This will be accomplished by monitoring changes in predator abundance, particularly Sacramento squawfish *Ptychocheilus grandis* (squawfish) and striped bass *Morone saxatilis*, in the immediate vicinity of the RBDD and the Red Bluff Research Pumping Plant (RPP). If necessary, recommendations for reducing predation on juvenile salmon will be made. Stressors, such as migrational barriers which delay squawfish and striped bass and create ambush habitats for these predators, have negative effects on populations of downstream migrating salmonids. Priority species effected by this project include: winter chinook, spring chinook, steelhead trout, late-fall chinook and green sturgeon. Specific objectives are to: 1) estimate seasonal relative abundance of aquatic predators in the immediate vicinity of RBDD, including the RPP trash racks, bypass outfall structure, and an undeveloped site downstream of the dam for characterizing natural river conditions; 2) determine squawfish and striped bass food habits to evaluate predation on migrating juvenile salmonids; and 3) gain insight into squawfish and striped bass life histories by tracking movements and population age structure and growth.
- The primary benefits of this project are precise indices of squawfish and striped bass abundance in the vicinity of the man-made structures at RBDD. The fact that the dam gates at RBDD are removed after each irrigation season to restore free flowing river conditions to the area provides a unique opportunity to compare predatory impacts at a large migratory barrier to impacts in the same area when that barrier is removed. It will allow evaluation of the effectiveness of operational and structural improvements at RBDD and how they effect abundance of squawfish and striped bass near the structure. It will also contribute to our knowledge of squawfish life history, a native fish of the Sacramento River.
- c. **Approach.**—The study area will be stratified into six specific sampling transects. Five of the transects will run adjacent to the man-made structures around and including the dam. These five sampling transects will include the west downstream side of the dam, the east downstream side of the dam, the bypass outfall structure, the RPP trash racks, and sheet-piling wall directly downstream of the RPP trash racks. The sixth transect will be used as a control, and will be located at a natural free flowing site approximately one-mile downstream of the dam. Standardized sampling of these six transects will allow comparisons between the man-made structures around and including the dam, and between man-made and a natural river environment. The abundance indices will provide researchers and managers the ability to track population trends over time.
- Transects will be sampled weekly. Squawfish and striped bass will be collected using a combination of angling and electrofishing. These two sampling techniques have proven to be effective and complementary in that electrofishing has been effective in shallow shoreline areas and angling in deep swift areas. A Smith-Root electrofishing boat, equipped with smooth mode shocking abilities to cause less harm to fish, will be employed. fork lengths (mm), and wet weights (g) will be recorded from all squawfish and striped bass captured.
- Tasks.**—This project has been funded by the Bureau of Reclamation (Reclamation) since 1994 as part of the evaluation of the RPP. Reclamation funding will likely cease after fiscal year 1998 when in-river evaluations of the RPP are complete. This task would fund the continuation

of this monitoring to FY '99 and '00.

**Schedule.**—Field work for the pilot program began in July 1994 and extended through summer 1995. Field work has been continuous since 1994 and a progress report was completed in the winter of 1997. Through this funding, sampling would continue on a weekly basis through 2000.

**Report Schedule.**—Reports will be submitted annually and real time data provide through the Interagency Ecological Program web site.

- d. **Justification for Project Funding by CALFED.**—The RBDD site is below the spawning areas of priority species: winter chinook, main stem spring chinook, late-fall chinook, green sturgeon and steelhead trout. Splittail are also in the RBDD area. Operational and structural changes at RBDD have/and will be developed as part of ecosystem restoration programs. These fixes should not create new attraction for aquatic predators. Sampling at this site would benefit numerous programs involving the restoration of these fishes. Juvenile sampling at RBDD is consistent with recommendation of other ecosystem restoration programs, such as: Central Valley Project Improvement Act (CVPIA), Red Bluff Diversion Dam CVPIA (3406 [b] 10) actions and planning process, Anadromous Fisheries Restoration Program (AFRP), Comprehensive Assessment and Monitoring Program (CAMP) and Red Bluff Research Pumping Plant Evaluations .
- e. **Budget Costs.**—Annual costs for continuation of full scale sampling and reporting for FY '99 and '00 is \$88,400 per year. No major capitol expenditures will be required since the project would use existing boats and electrofishing gear. This project is envisioned as multi-year and would continue as long as the data is needed by managers and researchers working on restoration projects in the basin.

**Third Party Impacts.**—No third party impacts will occur during this project.
- f. **Applicant Qualifications.**—The Northern Central Valley Fish and Wildlife Office (NCVFWO) was established in 1978 as part of the U.S. Fish and Wildlife Service's (Service) responsibility to facilitate restoration of Pacific salmonids. The construction and operation of dams and water diversion projects and the subsequent degradation and loss of habitat have been the primary contributors to the decline in all anadromous salmonid stocks in the upper Sacramento River. Specific goals of the NCVFWO are to: 1) Stabilize or increase the runs of anadromous salmonids in the Sacramento River system, 2) Improve the effectiveness of federal fish propagation facilities in California and Nevada, 3) Protect and restore the productivity of natural habitats in the Sacramento River system, and 4) Continue development of information and strategies for protecting the natural habitats of the Sacramento River system as migration routes, spawning areas, and nursery areas for anadromous salmonids. The staff consists of 30 biologists and support staff, most of whom are already working in the upper Sacramento River.
- g. **Monitoring and Data Evaluation.**—This is a monitoring project whose data will be used in a variety of management and research efforts. Data evaluation and peer review are critical to the success of this project. Primary project review will occur within the Service, Reclamation, IEP and California Department of Fish and Game. This data is integrated into the RPP evaluation and IEP programs.
- h. **Local Support/Coordination with other Programs/Compatibility with CALFED objectives.**—Sampling at the RBDD benefits numerous restoration programs, coordinating and integrating data for the RPP, IEP, CAMP and AFRP programs. RBDD sampling is supported by the Salmon Project Work Team of the IEP. Main stem juvenile monitoring at RBDD have been identified in all current restoration planning documents: *Upper Sacramento River Fisheries and Riparian Habitat Management Plan*, *Central Valley Salmon and Steelhead Restoration and Enhancement Plan*, *Restoring Central Valley Streams: A Plan for Action*, and *Steelhead Restoration and Management Plan for California*, and *Working Paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 1, 2 and 3.*

**SPACIAL AND SEASONAL ABUNDANCE OF AQUATIC PISCIVORES,  
SACRAMENTO SQUAWFISH *Ptychocheilus grandis* and STRIPED BASS *Morone  
saxatilis*, AROUND THE VARIOUS IN-RIVER STRUCTURES ASSOCIATED WITH  
WATER DIVERSION ACTIVITIES AT RED BLUFF DIVERSION DAM,  
SACRAMENTO RIVER, CALIFORNIA**

U.S. Fish and Wildlife Service  
Northern Central Valley Fish and Wildlife Office

Principal Investigators—Rich Johnson and Michael Tucker

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Federal Agency—Tax Exempt, Tax I.D. # K310715

Participants/Collaborators—U. S. Bureau of Reclamation

June 1998



#### IV.

#### Project Description

- a. **Project Description and Approach.**—The goal of this project is to determine if man-made structures at Red Bluff Diversion Dam (RBDD) are constructed and operated in a manner that creates no new local attraction for aquatic piscivores and no increase in predation on downstream migrating juvenile chinook salmon *Oncorhynchus tshawytscha* and steelhead trout *Oncorhynchus mykiss*. This will be accomplished by monitoring changes in predator abundance, particularly Sacramento squawfish *Ptychocheilus grandis* (squawfish) and striped bass *Morone saxatilis*, in the immediate vicinity of the RBDD and the Red Bluff Research Pumping Plant (RPP). If necessary, recommendations for reducing predation on juvenile salmon will be made. Stressors, such as migrational barriers which delay squawfish and striped bass and create ambush habitats for these predators, have negative effects on populations of downstream migrating salmonids. Priority species effected by this project include: winter chinook, spring chinook, late fall chinook and green sturgeon. Specific objectives are to: 1) estimate seasonal relative abundance of aquatic predators in the immediate vicinity of RBDD, including the RPP trash racks, bypass outfall structure, and an undeveloped site downstream of the dam for characterizing natural river conditions; 2) determine squawfish and striped bass food habits to evaluate predation on migrating juvenile salmonids; and 3) gain insight into squawfish and striped bass life histories by tracking movements and population age structure and growth.

The primary benefits of this project are precise indices of squawfish and striped bass abundance in the vicinity of the man-made structures at RBDD. The fact that the dam gates at RBDD are removed after each irrigation season to restore free flowing river conditions to the area provides a unique opportunity to compare predatory impacts at a large migratory barrier to impacts in the same area when that barrier is removed. It will allow evaluation of the effectiveness of operational and structural improvements at RBDD and how they effect abundance of squawfish and striped bass near the structure. It will also contribute to our knowledge of squawfish life history, a native fish of the Sacramento River.

**Proposed Scope of Work.**—The study area will be stratified into six specific sampling transects. Five of the transects will run adjacent to the man-made structures around and including the dam. These five sampling transects will include the west downstream side of the dam, the east downstream side of the dam, the bypass outfall structure, the RPP trash racks, and sheet-piling wall directly downstream of the RPP trash racks. The sixth transect will be used as a control, and will be located at a natural free flowing site approximately one-mile downstream of the dam. Standardized sampling of these six transects will allow comparisons between the man-made structures around and including the dam, and between man-made and a natural river environment. The abundance indices will provide researchers and managers the ability to track population trends over time.

Transects will be sampled weekly. Squawfish and striped bass will be collected using a combination of angling and electrofishing. These two sampling techniques have proven to be effective and complementary in that electrofishing has been effective in shallow shoreline areas and angling in deep swift areas. A Smith-Root electrofishing boat, equipped with Smooth Mode Shocking abilities to cause less harm to fish, will be employed. Fork lengths (mm), and wet weights (g) will be recorded from all squawfish and striped bass captured.

- b. **Location and/or Geographic Boundaries of Project.**—The RBDD is located in the Sacramento River at river kilometer 388 (river mile 243) about 3 kilometers southeast of the city

of Red Bluff, Tehama County. It was completed in 1964, and began operation in 1966. The purpose of the dam is to divert water into the Tehama-Colusa and Corning Canal system, for agriculture and wildlife refuges. The dam consists of eleven moveable gates which can be raised or lowered to impound and divert river flows into the canal.

- c. **Expected Benefits:** Continuing this study over an extended period of time will allow us to identify trends in predator abundance corresponding to varying operational scenarios of the dam and RPP (e.g. gates in and out, pumps running and not running) as well as variations in other environmental factors such as river flows, water temperature, and adult salmon run size. Data collected thus far in the study shows preliminary evidence that "gates out" operations at RBDD has significantly reduced predator densities below the dam and that predator densities show a marked increase each year when the gates are put in. Further investigations will be critical in solidifying the proof that "gates out" operations are responsible for an important reduction in one of the primary stressors facing outmigrating juvenile salmonids (i.e. predation).

Species which will benefit from an increased knowledge of predator prey interactions at the dam include all four runs of chinook salmon, steelhead trout, and green sturgeon, all of which have juveniles passing the dam at various times throughout the year.

A secondary benefit of conducting this study is that it will coincide with a Sacramento squawfish radio telemetry study in which squawfish will be implanted with radio transmitters and their movements tracked around the same study area. Having these two studies running simultaneously will help greatly in understanding and analyzing the data collected from each.

Restoration actions which would be supported by main stem juvenile monitoring at RBDD have been identified in all current restoration planning documents (Resources Agency 1989, Reynolds et al. 1990, Reynolds et al. 1993, Anadromous Fish Restoration Plan (AFRP) {U. S. Fish and Wildlife Service 1995}, and McEwan and Jackson 1996, Comprehensive Monitoring and Assessment Program {CAMP; U. S. Fish and Wildlife Service 1996}). The RBDD is an excellent sampling location below the spawning areas of winter chinook, main stem spring chinook, late-fall chinook, steelhead trout and green sturgeon. Adult splittail have also been captured recently marking their upper distribution.

Juvenile sampling at RBDD is consistent with recommendation of other ecosystem restoration programs, such as: Central Valley Project Improvement Act (CVPIA), Red Bluff Diversion Dam CVPIA (3406 [b] 10) actions and planning process, Anadromous Fisheries Restoration Program (AFRP), Comprehensive Assessment and Monitoring Program (CAMP) and Red Bluff Research Pumping Plant Evaluations .

- d. **Background and Biological /Technical Justification:** As previously stated this proposal is for the continuation of efforts which were part of a study analyzing abundance, food habits, and life history of Sacramento squawfish and striped bass, near the research pumping plant intake structure. The original purpose was to determine if the pumping plant could be constructed and operated in a manner that created no new local attraction for fish predators and no increase in predation on downstream migrating juvenile chinook salmon. The previously collected data creates an excellent head start in that over 700 squawfish and 80 striped bass have already been tagged and released into the study area. We also have a limited stomach contents analysis and a strong background of life history information. Eleven quarterly reports on all previous activities are available and a progress report summarizing the first years of data was completed in February, 1998 (Tucker et al. 1998).

Fish ladders at RBDD are inefficient at passing migrating adult salmon. Squawfish and

striped bass are also delayed and blocked at the dam. This is most apparent in the spring when squawfish can become very numerous below RBDD. This accumulation may be due to blockage of squawfish during their spawning migration.

Problems in passage of juvenile salmonids also exist at RBDD. A cause of mortality in juvenile chinook salmon is from the dysfunctional predator-prey relation created by RBDD—largely from the Sacramento squawfish. The piscivorous nature of Sacramento squawfish, as well as their preference for salmonids, is well documented (Vondracek and Moyle 1982, 1983); however, they have not been systematically studied immediately below RBDD (Garcia 1989). The Sacramento squawfish is a native species that co-evolved in the river with chinook salmon and steelhead. In the natural free flowing river setting, the predator-prey relationship between the Sacramento squawfish and the native salmonids is intact and has no significant effect on salmonid populations (Brown and Moyle 1981). Whereas, man-made structures can provide increased feeding and ambush settings creating an unnatural advantage for predators. Other piscivores present below RBDD include striped bass *Morone saxatilis* rainbow/steelhead trout *Oncorhynchus mykiss*, and American shad *Alosa sapidissima* as well as numerous other fish and bird species.

In October 1983, Reclamation, the Service, CDFG, NMFS and California Department of Water Resources initiated a five-year Fish Passage Action Program to develop methods to improve upstream and downstream passage at RBDD. The program identified numerous problems at RBDD in which some, but not all, have been addressed. For example, since 1987 the Reclamation has raised the RBDD gates during a significant portion of the non-irrigation season, allowing free passage of adults during that period. Raising the RBDD gates during the non-irrigation season dramatically improves upstream fish passage (Northern Central Valley Fishery Resource Office, USFWS, Red Bluff, California, unpublished data).

For 20 years the RBDD gates remained closed year-round, until winter of 1986 when the gates were raised during the nonirrigating season to improve fish passage. During periods when the gates are raised at RBDD there is still need for irrigation water. To supply this water, Reclamation is investigating the use of fish friendly pumps at the RPP. The evaluation of effects that the RPP may have on predator (squawfish and striped bass) abundance has been funded by Reclamation since 1994 as part of the evaluation of the entire RPP facility. Reclamation funding will likely cease after fiscal year 1998 when in-river evaluations of the RPP are complete. This proposal would fund the continuation of this monitoring to FY '99 and '00. No other alternatives exist for gathering information about Sacramento squawfish and striped bass in the upper Sacramento River and how these piscivores might be affected by various operation scenarios at the diversion complex.

- e. **Analysis of Abundance.**—Healthy, uninjured squawfish and striped bass will be released with a numbered Floy® anchor tag to allow individual identification. Subsequently, all squawfish and striped bass caught will be examined to track movements and growth rates.

Relative abundance will be estimated from catch data of squawfish and striped bass and expressed as catch per hour per transect. The hypothesis that sample sites have equal fish densities will be tested using a nonparametric Tukey's HSD test. The hypothesis that temporal strata (representing various dam operation scenarios and seasonal/environmental variations) produce equal fish densities will be tested using a Wilcoxon paired-sample test.

**Tasks.**—This project has been funded by Reclamation since 1994 as part of the evaluation of the RPP. Reclamation funding will likely cease after fiscal year 1998 when in-river evaluations

of the RPP are complete. This task would fund the continuation of this monitoring to FY '99 and '00.

**ERPP Objectives and Stressors.**—Several implementation objectives and stressors found in the ERPP will be addressed by this project. The vision statement under the Predation and Competition section of Volume 1 (pp. 322) states “The vision for predation and competition is to reduce unnatural levels (of predation) to restore fish populations by removing, redesigning, or reoperating inwater structures, diversion dams and hatchery practices.” One of the implementation objectives for this section (pp. 323) is “preventing predatory fish from congregating below the Red Bluff Diversion Dam by modifying operations”.

The Implementation Objective section for chinook salmon in Volume 1 (pp. 153) states that “the overall target for chinook salmon is presented as a strategy to increase the survival and return of each generation”. One of the objectives for meeting this target is stated on page 154 of this section as “Eliminate stressors that cause direct or indirect mortality of chinook salmon. Important stressors on chinook salmon include..predation near human constructed structures..”. Likewise, for steelhead trout, predation at these types of human constructed structures can be a source of juvenile mortality. One of the implementation objectives stated for steelhead trout in Volume 1 (pp. 160) is to “create and improve habitat conditions and reduce sources of mortality”.

Finally, the Water Diversions section of Volume 1 (pp. 277) states as one of the implementation objectives; “Support completion of research at the Red Bluff Research Program” of which this project is a part.

The study of predatory impacts below RBDD and how those predators react to the various structures and operational scenarios associated with the diversion complex will help to meet the above mentioned goals by identifying ways to alleviate the stressors put on priority species by these types of water diversion operations.

**Schedule.**—Field work for the pilot program began in July 1994 and extended through summer 1995. Analyses for the pilot year and a progress report will be available summer of 1997. Work will be continuous through FY '98, '99 and '00.

**Report Schedule.**—Reports will be submitted in December '98, '99 and '00.

**f. Monitoring and Data Evaluation**

This is a monitoring project whose data will be used in a variety of management and research efforts. Data evaluation and peer review are critical to the success of this project. Primary project review will occur within the Service, Reclamation, IEP and local California Department of Fish and Game. This data is integrated into the Research Pumping Plant evaluation and IEP programs.

Quarterly reports are currently reviewed by an Interagency Technical Team which consists of Reclamation, NMFS, CDFG, Service and stakeholder review. When in-river-RPP evaluations are completed in 1999, monitoring data will be circulated to agency personnel and stakeholders in a manner consistent with IEP, CAMP and AFRP.

**g. Implementability**

The RBDD monitoring project complies with all laws and regulations. It is included in the Service's Endangered Species section 10 permit for the directed take of winter chinook, state scientific collection permits and the States MOA on Service sampling in the Sacramento River and it's tributaries. NEPA documentation for AFRP activities will be covered with the completion of the Programmatic Environmental Impact Statement currently in preparation which

should be completed soon.

**Outreach.**—An outreach opportunity exists by coordinating field activities with the Sacramento River Discovery Center. This would provide educational opportunities between a CALFED sponsored program and local school districts. To date, high-school students from the Center have worked with biologists on this project and have produced written reports of their activities. The project has also provided educational demonstrations for elementary aged students.

## References

- Brown, L. R. and P. B. Moyle. 1981. The impact of squawfish on salmonid populations: A review. *North American Journal of Fisheries Management* 1:104-111.
- Garcia, A. 1989. The impacts of squawfish predation on juvenile chinook salmon at Red Bluff Diversion Dam and other locations in the Sacramento River. U. S. Fish and Wildlife Service, Report Number AFF-FAO-89-05, Northern Central Valley Fishery Resource Office, Red Bluff, California.
- McEwan, Dennis, and Terry A. Jackson. 1996. Steelhead Restoration and Management Plan for California. The Resource Agency, State of California, Department of Fish and Game pp. 234
- Resources Agency. 1989. Upper Sacramento River Fisheries and Riparian Habitat Management Plan. Prepared for the Resources Agency by an Advisory Council established by SB 1086, authored by Senator Jim Nielsen 158 pp.
- Reynolds, F. L., T. J. Mills, and J. Schuler. 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. California Department of Fish and Game, Inland Fisheries Division 115 pp.
- Reynolds, F. L., T. J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action. California Department of Fish and Game, Inland Fisheries Division.
- Tucker, M. E., C. M. Williams and R. R. Johnson. 1998. Abundance, food habits and life history aspects of Sacramento squawfish and striped bass at the Red Bluff Diversion Complex, including the Research Pumping Plant, Sacramento River, California, 1994-1996. Red Bluff Research Pumping Plant Report Series, Volume 4. U. S. Fish and Wildlife Service, Red Bluff, California
- U. S. Fish and Wildlife Service. 1995. Working Paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 1, 2 and 3. May 9, 1995. Prepared for the U. S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, California.
- U. S. Fish and Wildlife Service. 1996. The Comprehensive Monitoring Plan to Evaluate the Relative Effectiveness of CVPIA Actions in Restoring Anadromous Fish Production. Technical Memorandum 2. Administrative Draft. Sacramento, California.

Vondracek, B., and P. B. Moyle. 1982. The biology of the Sacramento squawfish *Ptychocheilus grandis* and predation on juvenile salmon *Oncorhynchus tshawytscha* in the Sacramento River. Annual Report to the California Department of Water Resources, Sacramento, California.

Vondracek, B., and P. B. Moyle. 1983. Squawfish predation at Red Bluff Diversion Dam. Report to the California Department of Water Resources, Sacramento, California.

V.

**Budget Costs**

- a. **Budget Costs.**—Table 1 has project costs for this task, which continues a full scale project for FY '99 and beyond. This project is envisioned as multi-year and would continue as long as the data is needed by managers and researchers working on restoration projects in the basin. This project would require no major capital expenditures for equipment, using existing boats, trucks and electrofishing gear.

Table 1.—Annual budget (4 days per month sampling). This project would use existing boats and electrofishing gear.

Project Phase	Direct Labor Hours	Direct Salary and Benefits	Overhead Labor (General, Administration and fee)	Service Contracts	Material and Acquisition Contracts	Misc. and other Direct Costs	Total Costs
Phase II	3,000	\$57,000	\$12,540	\$0	\$8,540	\$7,320	\$88,400

CALFED funding will be required at completion of RPP evaluations by Reclamation in FY '98. Funding could potentially be shared between AFRP and CAMP programs, if and when that funding becomes available.

- b. **Schedules and Milestones.**—Field work for the pilot program began in July 1994 and extended through summer 1995. Analyses for the pilot year and a progress report is currently available. Work will be continuous through FY '98.
- c. **Third Party Impacts.**—None.

**VI. Applicant Qualifications.**—The Northern Central Valley Fish and Wildlife Office (NCVFWO) was established in 1978 as part of the U.S. Fish and Wildlife Service's (Service) responsibility to facilitate restoration of Pacific salmonids. The construction and operation of dams and water diversion projects and the subsequent degradation and loss of habitat have been the primary contributors to the decline in all anadromous salmonid stocks in the upper Sacramento River. Specific goals of the NCVFWO are to: 1) Stabilize or increase the runs of anadromous salmonids in the Sacramento River system, 2) Improve the effectiveness of federal fish propagation facilities in California and Nevada, 3) Protect and restore the productivity of natural habitats in the Sacramento River system, and 4) Continue development of information and strategies for protecting the natural habitats of the Sacramento River system as migration routes, spawning areas, and nursery areas for anadromous salmonids. The staff consists of 30 biologists and support staff, most of whom are already working in the upper Sacramento River.

**Project Personnel and Qualifications**

**James G. Smith.**—Mr. Smith's position is with the U.S. Fish and Wildlife Service as Project Leader at the Northern Central Valley Fish and Wildlife Office at Red Bluff where he is responsible for the management of a 30 person office. Mr. Smith received a B. S. degree with major in fishery biology from Humboldt State University in 1975 and did post-graduate studies at the same from 1976-79. He has worked as a professional biologist for 18 years in Oregon, Washington and California. For the past fourteen years he has been personally involved with numerous fishery studies involving salmon including fish passage investigations at RBDD, monitoring downstream migrations of juvenile salmonids, hatchery evaluation efforts at Coleman NFH, and salmon spawning gravel restoration evaluation activities. The office has responsibilities that include identifying and defining factors affecting the abundance and survival of anadromous salmonids produced in the Sacramento River Basin, California. Mr. Smith works on a daily basis with numerous federal, state, and private entities in developing actions and programs for restoring, conserving, and enhancing anadromous salmonids in the upper Sacramento River.

**Richard R. Johnson.**—Mr. Johnson is a 1976 graduate from Humboldt State University (B.S.), with major in fishery biology. He did post-graduate work at the University of Alaska, Fairbanks from 1990-91. He has been a professional fishery biologist for 19 years. Mr. Johnson has experience as a commercial salmon fisherman in California, and in commercial and federal hatcheries in California, Ohio, and Michigan. He spent 7 years as a management biologist in Fairbanks, Alaska working with lake trout, Arctic char, northern pike and various whitefish species, before arriving at the Service's Northern Central Valley Fish and Wildlife Office in Red Bluff, California 6 years ago, where he is the Deputy Project Leader.

**Michael Tucker.**—Mr. Tucker is a 1990 graduate of The University of Wisconsin in Madison, where he acquired a bachelors of science degree in Wildlife Ecology. He has over seven years of professional experience as a fishery biologist for the Fish and Wildlife Service. He began his career in Grand Junction, Colorado working in an endangered species recovery program for several Federally listed fish in the Colorado River. He came to California in 1995 where he has since been working on evaluations of the Red Bluff Research Pumping Plant out of the Service's Red Bluff Office.

**VII. Compliance with Standard Terms and Conditions.**—We will provide the appropriate documents and signatures regarding Submittal/Compliance of Standard Terms and Conditions, prior to signing final contracts, as indicated in the Table D-1 matrix of Standard Clauses/Proposal Request for a public agency proposing a Group 3 (Services) application type.